Design and Conceptualization of a Universal Non-Contact 3D Rada r-Based Human Body Scanner for Multiscale Biomedical Imaging

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 Abstract:

This paper presents the conceptual framework and design of a universal, non-contact, radar-based 3D human body scanner capable of visualizing both external anatomical structures and internal cellular dynamics. Unlike conventional imaging modalities such as MRI, CT, or ultrasound, the proposed system integrates multimodal radar, photonic, and AI-enhanced imaging technologies to achieve full-body voxel reconstruction and dynamic biological simulation. The device aims to revolutionize diagnostics, cancer detection, and regenerative medicine by enabling real-time, contactless visualization of tissue morphology, organ function, and cellular processes such as mitosis.

 1. Introduction

Current medical imaging systems are limited by contact requirements, radiation exposure, or lack of cellular resolution. This paper proposes a novel scanner that combines radar tomography, biophotonics, and AI modeling to overcome these limitations. The goal is to create a portable, modular system capable of scanning the human body in 3D — from skin to cellular activity — without physical contact.

 2. System Architecture

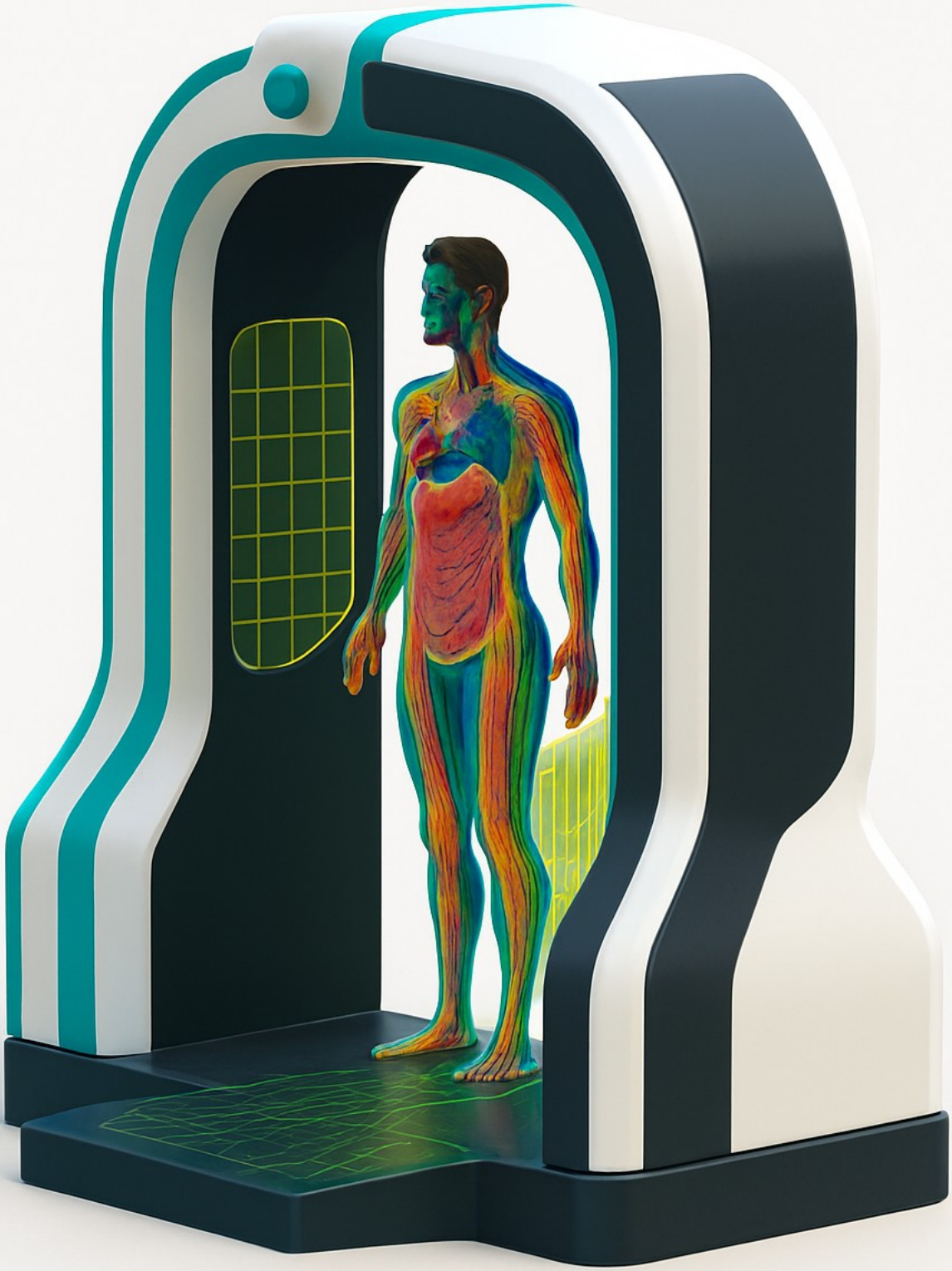
2.1 Sensor Array

- **FMCW Radar (60–120 GHz)**: Captures chest motion, organ boundaries, and tissue density.
- **UWB Radar**: Penetrates deeper layers for internal mapping.
- **Photoacoustic Emitters**: Laser-induced ultrasound for vascular and cellular imaging.
- **Quantum Dot Biophotonics**: Tunable nanoscale light for sub-cellular visualization.
- **VOC Sensors**: Detect breath-based biomarkers for cancer and metabolic disorders.

2.2 Processing Unit

- **AI Engine**: Multi-branch neural network for signal fusion and anatomical classification.
- **Real-Time Voxel Renderer**: Converts radar and optical signals into dynamic 3D models.
- **Display Interface**: Holographic or AR-based visualization of body scan.

 3. Imaging Capabilities



⚙ 4. Applications

- **Cancer Detection**: Identifies pre-cancerous zones and tumor margins.
- **Regenerative Monitoring**: Tracks stem cell activity and tissue healing.
- **Digital Twin Modeling**: Creates personalized anatomical simulations.
- **Remote Diagnostics**: Enables rural and telemedicine deployment.

 5. Challenges

- Signal scattering in tissue
- Calibration across body types
- Data volume and real-time processing
- Safety and regulatory compliance

 6. Future Work

- Integration with genomic inference
- Quantum imaging enhancement
- Clinical trials and AI model training
- Patent filing and industrial prototyping

 References

1. Pandya, H., Subramaniam, N. (2025). “2-Minute Cancer Detection Device.” *MedBound Times*
2. MIT THz Imaging Lab (2024). “Terahertz Imaging for Deep Tissue Diagnostics.”
3. Stanford SLAM Microscopy (2023). “Real-Time Cell Division Tracking.”
4. Binah.ai, Lifelight, Anura — Commercial contactless health platforms.